The Drosophila MI-2 chromatin-remodeling factor regulates higher-order chromatin structure and cohesin dynamics in vivo.

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Public Summary:
dMi-2 is a highly conserved ATP-dependent chromatin-remodeling factor that regulates transcription and cell fates by altering the structure or positioning of nucleosomes. Here we report an unanticipated role for dMi-2 in the regulation of higher-order chromatin structure in Drosophila. Loss of dMi-2 function causes salivary gland polytene chromosomes to lose their characteristic banding pattern and appear more condensed than normal. Conversely, increased expression of dMi-2 triggers decondensation of polytene chromosomes accompanied by a significant increase in nuclear volume; this effect is relatively rapid and is dependent on the ATPase activity of dMi-2. Live analysis revealed that dMi-2 disrupts interactions between the aligned chromatids of salivary gland polytene chromosomes. dMi-2 and the cohesin complex are enriched at sites of active transcription; fluorescence-recovery after photobleaching (FRAP) assays showed that dMi-2 decreases stable association of cohesin with polytene chromosomes. These findings demonstrate that dMi-2 is an important regulator of both chromosome condensation and cohesin binding in interphase cells.

Scientific Abstract:
dMi-2 is a highly conserved ATP-dependent chromatin-remodeling factor that regulates transcription and cell fates by altering the structure or positioning of nucleosomes. Here we report an unanticipated role for dMi-2 in the regulation of higher-order chromatin structure in Drosophila. Loss of dMi-2 function causes salivary gland polytene chromosomes to lose their characteristic banding pattern and appear more condensed than normal. Conversely, increased expression of dMi-2 triggers decondensation of polytene chromosomes accompanied by a significant increase in nuclear volume; this effect is relatively rapid and is dependent on the ATPase activity of dMi-2. Live analysis revealed that dMi-2 disrupts interactions between the aligned chromatids of salivary gland polytene chromosomes. dMi-2 and the cohesin complex are enriched at sites of active transcription; fluorescence-recovery after photobleaching (FRAP) assays showed that dMi-2 decreases stable association of cohesin with polytene chromosomes. These findings demonstrate that dMi-2 is an important regulator of both chromosome condensation and cohesin binding in interphase cells.